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Health & Environmental Impact of Ultraviolet Radiation Exposure used in Currency Sanitizer

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Abstract: ***Many of the ultraviolet (UV) sources used emit high intensities of UV light, capable of producing painful eye and skin burns. This paper provides information about the hazards associated with UV exposure and the safety precautions to take when working with these sources. Ultraviolet (UV) disinfection technology has existed for many years, but chemicals are still very prominent in disinfection applications today. UV disinfection does, however, provide many benefits over chemical options. It cannot be overdosed, and does not produce by-products, toxins, or volatile organic compound (VOC) emissions. It does not require the storage of hazardous materials and will not affect smell or taste in water and food disinfection applications. In addition, UV light is known to kill more waterborne microbes than chlorination. UV-C currency sanitizer is a fluid less device which can be used to perform the disinfection of various bacteria and viruses, it is based on UV-C light technology. It provides a portable ultraviolet disinfecting device for currency notes which comprises an acrylic case. The light is arranged in the top and bottom and inner layer coated with aluminum foil to increase the utilization of light rays.***
Keywords: UVC light, Currency sanitizer, Acrylic sheet

I. INTRODUCTION

UV light is a component of sunlight that falls in the region between visible light and X-rays on the electromagnetic spectrum, with a wavelength range of 100-400 nanometers (nm). Radiation in the UVC range of 250-280 nm deactivates bacteria, viruses, and other microbes by attacking their DNA-UVC light can penetrate the cells of microorganisms and disrupt the structure of the DNA molecule. It does this by destroying the genetic information inside the DNA. The microorganisms lose their reproductive capability and are destroyed, rendering them inactive and no longer harmful. The germicidal nature of UV is well suited to treat microorganisms which become extremely resistant to chemical disinfectants, as they are unable to develop immunity to UV radiation. Different pathogens have unique resistances to UV light. A correct UV dose is critical to thoroughly deactivate the intended microbes. It is a simple currency sanitizing device which ultraviolet C type light of wavelength (254 nm) to sanitize currency surface. In which 254 nm wavelength two 4w of light has the highest disinfectant capacity. The UVC light is falls on microbes or bacteria is absorbed by RNA and DNA in cells of microbes which induces changes in D-RNA structure that result in their inability to replicate and destroy them.

II. WHAT IS UV RADIATION

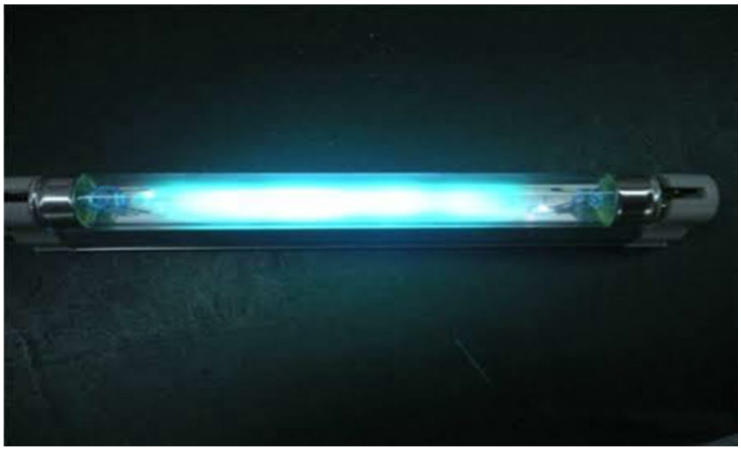

Figure 1. UV Lamp

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UV light is a component of sunlight that falls in the region between visible light and X-rays on the electromagnetic spectrum, with a wavelength range of 100-400 nanometers (nm), as shown in Figure 1.
This light can be further categorized into separate regions as follows:

1) UVA: 315—400 nm
2) UVB: 280—315 nm
3) UVC: 200—280 nm
4) Far UV (or "vacuum"): 100—200 nm

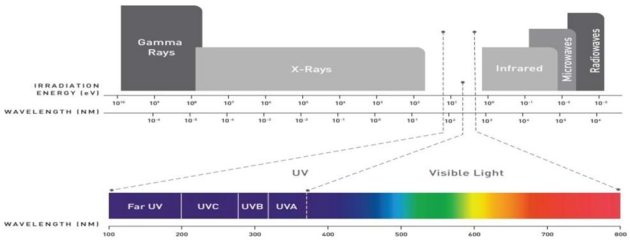

Figure 2. Types of UV rays

A. *Types of UV Light*

UVA light has the lowest amount of energy. When you're out in the sun, you're mainly being exposed to UVA light. Exposure to UVA light has been linked to skin aging and damage. UVB light sits in the middle of the UV light spectrum. A small portion of sunlight contains UVB light. It's the main type of UV light that contributes to sunburns and causes most skin cancers. UVC light has the most energy. UVC light from the sun is mostly absorbed in the Earth's ozone, so you're not normally exposed to it daily. However, there are various human-made sources of UVC light

B. *UVC Light for Disinfecting Surface*

The recent study, also published in the American Journal of Infection Control (AJIC), looked at using a specific type of UVC light to kill SARS-CoV-2 on laboratory surfaces. The study found that the UVC light reduced the live coronavirus by 99.7 percent in 30 seconds. The type of UVC light used in this study is called far-UVC light, which is UVC light between the wavelengths of 207 and 222 nanometers trusted Source. UVC light is the type of UV light that's most effective at killing germs. It can be used to disinfect surfaces, air, and liquids. UVC light kills germs like viruses and bacteria through damaging molecules like nucleic acids and proteins. This makes the germ incapable of performing the processes that it needs to survive.

III. HEALTH AND BIOLOGICAL IMPACT

1) *Eyes:* The epithelial cells of the cornea absorb radiation in the actinic portion of the UV spectrum (200 – 315 nm). This exposure produces symptoms known as photokeratitis, which are not felt until several hours after the exposure. Photokeratitis is very painful and produces the sensation of having sand in your eye. It also causes an aversion to bright light, as well as the production of tears. The effects typically last up to 48 hours but will disappear as the cells of the cornea are replaced. Most of the UV radiation that enters the eye is absorbed in the cornea, but UVA absorption by the lens can alter proteins in the lens.

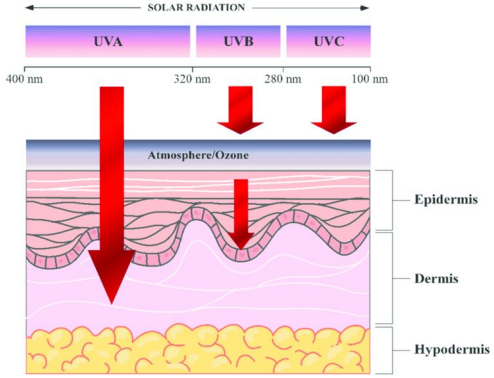

Figure 3. UV penetration on layers of skin

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2) Skin: Excessive UV exposure in the actinic range (200-315nm) produces symptoms that are comparable to sunburn and includes redness, swelling, pain, blistering, and peeling of the skin. Factors that can affect skin response to UV include your degree of skin pigmentation and photosensitization by certain foods (e.g., figs, limes, parsnips, and celery root) and drugs (e.g., tetracycline). You will recover from short-term skin damage, but chronic exposure to UV may increase your risk of skin cancer. For chronic(long-term) exposures, there is also a cumulative risk, which depends on amount of exposure during your lifetime.

IV. SAFETY IN CURRENCY SANITIZER

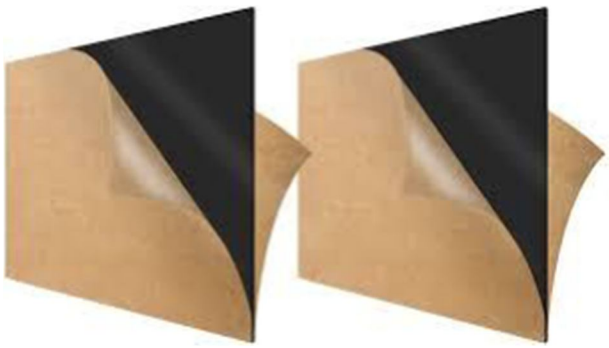

Figure 4. Acrylic sheets

UV-C light is a very energetic form of light that is not visible to the human eye. Based on our evaluation, UV-C light which is used for germicidal processes will not penetrate standard acrylic plastic sheets. The ability of UV-C light to penetrate materials will depend on the chemical composition of the materials. Most acrylic plastics will allow light of wavelength greater than 375 nm to pass through the material, but they will not allow UV-C wavelengths (100–290 nm) to pass through. Even very thin acrylic sheets of less than 5 millimeters (mm) do not let UV-C light penetrate. Therefore, you will be able to use standard acrylic plastic for your currency sanitizer equipment. Also, the ability of UV light to penetrate acrylic plastic is dependent on the chemical formulation.

A. UV Safety Precautions

1) Wear protective eyewear and gloves.
2) Cover all exposed skin.
3) Use a manual or electronic shutter to close the beam when the source is idle.
4) Be aware of reflective surfaces which can reflect UV radiation to unprotected parts of your skin.

V. CONCLUSION

After reviewing all the data, we found that UV light is beneficial as well as hazardous to the human health and its environment if not taken proper care. UV light can be use anywhere like home, hospitals, school, and many more places and equipment. UV Light should be fully automatic with no need of human interaction. Hence, UVC light can be fitted inside the currency sanitizer with use of safety acrylic plastic sheets. So, this device can be use very safely and as per the guideline of using UVC light.

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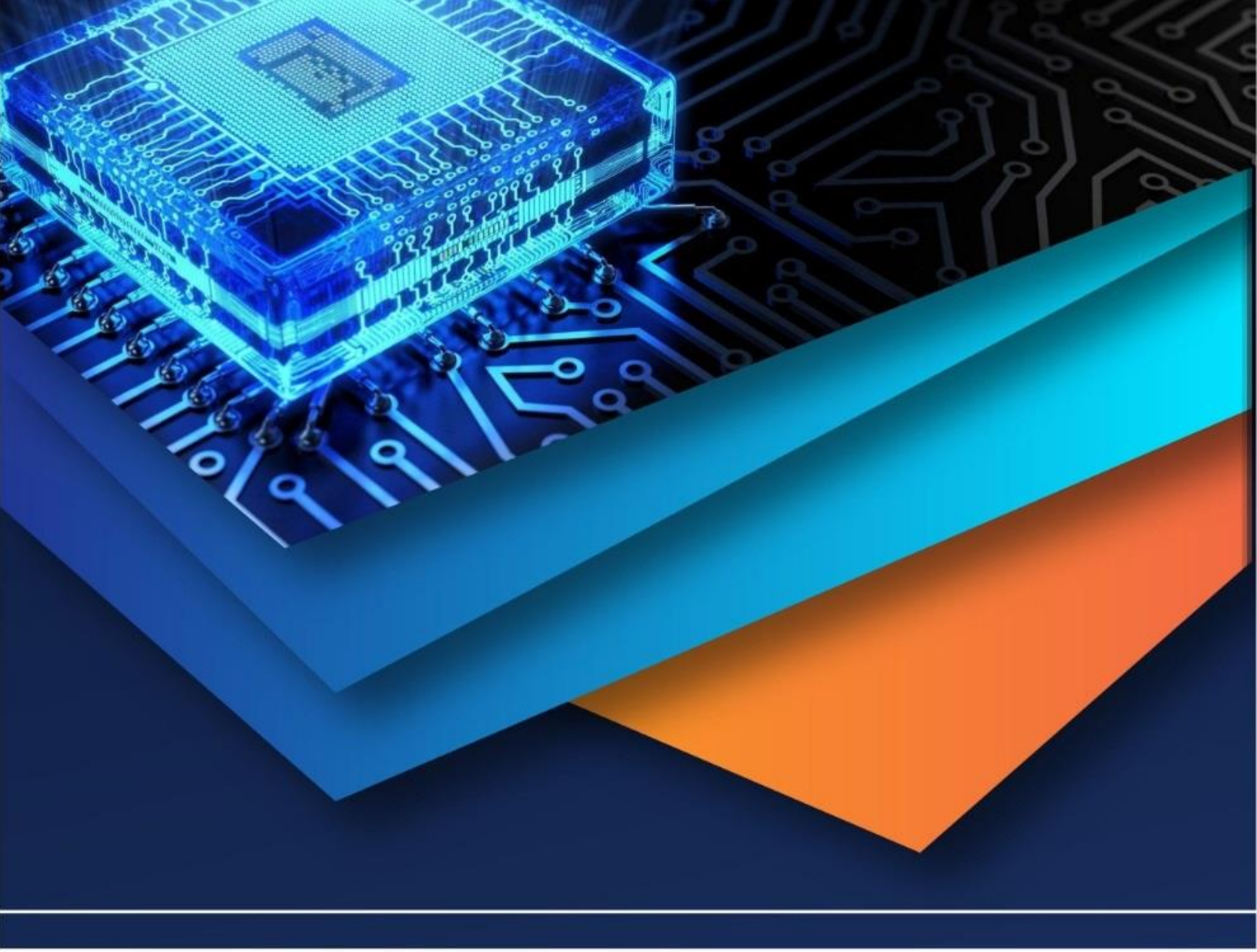

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